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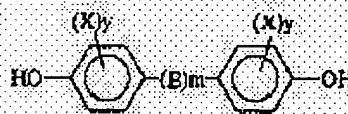
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## (54) PRODUCTION OF POLYCARBONATE FOR OPTICAL USE

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To continuously obtain a polycarbonate excellent in hue and little in foreign matter by reacting an aromatic dihydroxy compound with a diester of carbonic acid in the presence of a specific catalyst using a specific device and specifying its viscosity-average molecular weight.

**SOLUTION:** The objective compound having 10,000-20,000 viscosity average molecular weight and  $\leq 1,000$  ppm of terminal hydroxyl groups is continuously produced by transesterifying an aromatic dihydroxy compound expressed by formula I [B is a 1-15C hydrocarbon, a halogen-substituted hydrocarbon, -S-, -CO- or the like; X is a halogen, a 1-14C alkyl, a 6-18C aryl or the like; (m) is 0 or 1; (y) is 0-4] with a carbonic acid diester expressed by formula II [A and A' are each a 1-18C aliphatic, substituted aliphatic or a (substituted) aromatic group] in the presence of a catalyst comprising  $1 \times 10^{-8}$ - $1 \times 10^{-5}$  mole of an alkaline (earth) metal compound based on the ingredient A.



II

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the manufacture approach of the polycarbonate for optics by the so-called ester interchange method. A hue is excellent from an aromatic series dihydroxy compound and carbonic acid diester in detail, and it is related with the approach of manufacturing efficiently the aromatic series polycarbonate for optics with few foreign matters using cheap equipment.

[0002]

[Description of the Prior Art] The so-called ester interchange method for carrying out the polycondensation of the carbonic acid diester to an aromatic series dihydroxy compound, and manufacturing an aromatic series polycarbonate has a comparatively simple process compared with the phosgene method (interfacial polymerization), and it not only can demonstrate a predominance in respect of actuation and cost, but is improved from the field of environmental protection recently in the point of not using halogen system solvents, such as a strong toxic phosgene and a methylene chloride.

[0003] Moreover, although recent years come and the application of a polycarbonate has expanded the compact disk, the disk substrate for an information file, the optical lens, etc. as an ingredient for the so-called optics, in such an optical application, it is required that the contamination and volatile matter in an ingredient should be lessened as much as possible, and the ester interchange method which does not use a solvent attracts attention also in respect of quality.

[0004] However, the removal of a phenol which carries out a byproduction since the melt viscosity of a reaction mixture becomes high with the rise of the molecular weight of an aromatic series polycarbonate became difficult, the ester interchange method of a bulk-polymerization mold combined, and in the polymerization anaphase, since the amount of hydroxy groups of the polymer end used as a reacting point decreased, it had the trouble of being hard to go up molecular weight.

[0005] In order to solve this trouble, after manufacturing the prepolymer of low molecular weight with a vertical-type churning reactor as a pre-polymerization process, the approach of completing a polymerization, using horizontal-type churning polymerization equipment and a biaxial vent type extruder as a postpolymerization process is proposed (the patent No. 2628905 official report, JP,6-99552,B, JP,8-239465,A, JP,8-325374,A, JP,9-12703,A, JP,9-52035,A, JP,9-52946,A, JP,9-155175,A).

[0006] However, by the approach using horizontal-type churning polymerization equipment, there is a fault that coloring by YAKE, insoluble gel, generating of a crystallization object, etc. cause deterioration of physical properties or quality, from the problem on the equipment structure where resin tends to pile up partially, and it becomes a problem especially for the optical application which dislikes the contamination of a foreign matter.

[0007] Moreover, by the approach using a biaxial vent type extruder, since there is little throughput per unit volume since the hold up is small, and it became disadvantageous in respect of productivity and a scale-up and high shearing force was applied, there was a fault that deterioration of coloring of a polymer, gelation, etc. was intense, and it was unsuitable for manufacture of the polycarbonate for optics like the horizontal-type polymerization machine. Furthermore, these equipments are special polymerization equipment, and as compared with the reactor of a vertical type, equipment cost is very high and has the fault that maintenance nature, such as operation operability and washing, is also bad.

[0008] Only the technique of a batch polymerization method is known only for the cheap vertical-type churning reactor currently generally used about the approach of manufacturing a final product, without using such special polymerization equipment. However, it is not the manufacture approach suitable for manufacturing the polycarbonate for optics of which coloring and molecular weight change of resin occur while piling up, in order to take a long time to extract resin after polymerization termination and out of a reactor for productivity to be not only bad, but, or has the problem of a lot of resin which cannot finish escaping from a reactor remaining in a reactor in a batch polymerization method, and high quality is require.

[0009]

[Problem(s) to be Solved by the Invention] The purpose of this invention is excellent in a hue, and is to offer the approach of manufacturing continuously the polycarbonate for optics with few foreign matters only using a cheap vertical-type churning reactor.

[0010]

[Means for Solving the Problem] That this invention persons should solve the above-mentioned problem, if it is a polycarbonate for optics with comparatively low molecular weight as a result of inquiring wholeheartedly It can manufacture continuously only with the vertical-type churning reactor of three to 5 tub allotted to the serial. Still more preferably By using the polymerization equipment possessing a single helical ribbon aerofoil or a double helical ribbon aerofoil for the impeller of the last tub at least, a hue is excellent, and it finds out that the aromatic series polycarbonate of high quality with few foreign matters is obtained, and came to complete this invention.

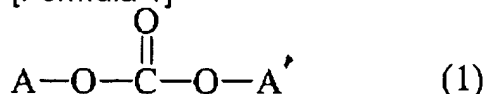
[0011] This invention an aromatic series dihydroxy compound and carbonic acid diester namely, in a raw material  $1 \times 10^{-8}$ - $1 \times 10^{-5}$  molar-quantity use of an alkali metal compound and/or the alkaline earth metal compound is carried out to one mol of aromatic series dihydroxy compounds as a catalyst. In the approach of manufacturing an aromatic series polycarbonate by the ester exchange reaction, only the vertical-type churning reactor of three to 5 tub allotted to the serial is used. Viscosity average molecular weight continuously by 10,000-20,000 And the amount of end hydroxy groups is involved in the approach of manufacturing the polycarbonate for optics which is 1,000 ppm or less. Furthermore, this invention relates to the approach of manufacturing the polycarbonate for optics using the polymerization equipment which possesses a single helical ribbon aerofoil or a double helical ribbon aerofoil in the impeller of the last tub at least, in the above-mentioned manufacture approach. [0012]

[Embodiment of the Invention] Hereafter, this invention is explained concretely.

[0013] As a raw material which manufactures the aromatic series polycarbonate concerning this invention, an aromatic series dihydroxy compound and carbonic acid diester are used. Carbonic acid diester is expressed with the following general formula (1).

[0014]

[Formula 1]



[0015] (The inside A of a formula and A' are the aliphatic series radicals, the permutation aliphatic series radicals, aromatic series radicals, or permutation aromatic series radicals of carbon numbers 1-18, and even if A and A' is the same, they may differ.)

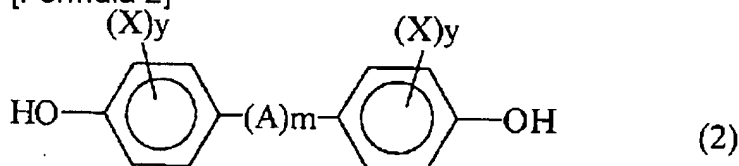
[0016] Although permutation diphenyl carbonate, such as dimethyl carbonate, diethyl carbonate, G t-butyl carbonate, diphenyl carbonate, and JITORIRU carbonate, etc. is illustrated, the carbonic acid diester expressed with the above-mentioned general formula (1) is diphenyl carbonate and permutation diphenyl carbonate preferably, and especially its diphenyl carbonate is desirable. These carbonic acid diester may mix independence or two sorts or more.

[0017] Moreover, dicarboxylic acid or dicarboxylic acid ester may be preferably used in the amount not more than 30 mol % still more preferably 50% or less with the above carbonic acid diester. As such dicarboxylic acid or dicarboxylic acid ester, a terephthalic acid, isophthalic acid, terephthalic-acid diphenyl, isophthalic acid diphenyl, etc. are used. Polyester carbonate is obtained when such a carboxylic acid or carboxylate is used together with carbonic acid diester.

[0018] The aromatic series dihydroxy compound which is another raw material is shown by the general formula (2).

[0019]

[Formula 2]



[0020] (B shows among a formula the radical of the hydrocarbon group which has the carbon number of 1-15, the hydrocarbon group of halogenation or -S-, -S2-, -SO2-, -SO-, -O-, and -CO-, and X shows a halogen atom, the alkyl group of carbon numbers 1-14, the aryl group of carbon numbers 6-18, the oxy-alkyl group of carbon numbers 1-8, and the oxy-aryl group of carbon numbers 6-18.) m is 0 or 1 and y is the integer of 0-4.

[0021] The aromatic series dihydroxy compound expressed with the above-mentioned general formula (2) For example, 2 and 2-screw (4-hydroxyphenyl) propane [= bisphenol A], 2 and 2-screw (4-hydroxy - 3, 5-dimethylphenyl) propane, 2 and 2-screw (4-hydroxy - 3, 5-diethyl phenyl) propane, 2 and 2-screw (4-hydroxy-(3, 5-diphenyl) phenyl) propane, 2 and 2-screw (4-hydroxy - 3, 5-dibromo phenyl) propane, 2 and 2-screw (4-hydroxyphenyl) pentane, 2, 4'-dihydroxy-diphenylmethane, Screw (4-hydroxyphenyl) methane, screw (4-hydroxy-5-nitrophenyl) methane, 1 and 1-screw (4-hydroxyphenyl) ethane, 3, and 3-screw (4-hydroxyphenyl) pentane, 1 and 1-screw (4-hydroxyphenyl) cyclohexane, a screw (4-hydroxyphenyl) sulfone, 2, 4'-dihydroxy diphenylsulfone, a screw (4-hydroxyphenyl) sulfide, -dihydroxy diphenyl ether, and 4 and 4' 4, 4'-dihydroxy -3, - dichlorodiphenyl ether, and 3 '4, 4'-dihydroxy -2, 5-diethoxy diphenyl ether, etc. are illustrated. 2 and 2-screw (4-hydroxyphenyl) propane is desirable also in these. Moreover, these aromatic series dihydroxy compounds are independent, or can mix and use two or more sorts, and can also use them as a copolymer if needed.

[0022] the mixing ratio of carbonic acid diester and an aromatic series dihydroxy compound – a rate is decided with the molecular weight and the amount of end hydroxy groups of an aromatic series polycarbonate for which it asks. In order for the amount of end hydroxy groups to have big effect on the thermal stability and hydrolytic stability of a product polycarbonate and to give physical properties practical as an object for optics, it is necessary to make it 1,000 ppm or less. Therefore, it is common to use carbonic acid diester more than an equimolecular

amount to one mol of aromatic series dihydroxy compounds, and it is desirable to be preferably used in the amount of 1.01-1.20 mols 1.01-1.30 mols.

[0023] In case an aromatic series polycarbonate is manufactured by the ester interchange method, an ester interchange catalyst is usually used. As an ester interchange catalyst, an alkali metal compound and/or an alkaline-earth-metal compound are mainly used, and it is also possible to use together basic compounds, such as a basic boron compound, basic phosphorus compounds, a basic ammonium compound, or an amine system compound, etc. auxiliary. These catalysts may be used by one kind and may be used combining two or more sorts.

[0024] The amount of catalysts used by this invention is used to one mol of aromatic series dihydroxy compounds in  $1 \times 10^{-8}$  to 1xten - five mols. Polymerization activity required to manufacture the polycarbonate of predetermined molecular weight and the amount of end hydroxy groups if fewer than this amount is not acquired, but when [ than this amount ] more, a polymer hue will get worse and the amount of foreign matters by generating of gel will also increase.

[0025] As an alkali metal compound, for example A sodium hydroxide, a potassium hydroxide, A lithium hydroxide, cesium hydroxide, a sodium hydrogencarbonate, a potassium hydrogencarbonate, A carbonic acid hydrogen lithium, carbonic acid hydrogen caesium, a sodium carbonate, potassium carbonate, A lithium carbonate, cesium carbonate, sodium acetate, potassium acetate, an acetic-acid lithium, Acetic-acid caesium, a sodium stearate, a stearin acid potassium, lithium stearate, Stearin acid caesium, a sodium borohydride, a boron hydride potassium, A lithium borohydride, boron hydride caesium, phenyl-ized boron sodium, A phenyl-ized boron potassium, a phenyl-ized boron lithium, phenyl-ized boron caesium, A sodium benzoate, a benzoic-acid potassium, a benzoic-acid lithium, benzoic-acid caesium, Disodium hydrogen-phosphate, dibasic potassium phosphate, phosphoric-acid hydrogen 2 lithium, Phosphoric-acid hydrogen 2 caesium, phenyl phosphoric-acid disodium, phenyl dibasic potassium phosphate, Phenyl phosphoric-acid 2 lithium, phenyl phosphoric-acid 2 caesium, sodium, a potassium, a lithium, the alcoholate of caesium, phenolate, the disodium salt of bisphenol A, 2 potassium salt, 2 lithium salt, 2 cesium salts, etc. are mentioned.

[0026] Moreover, as an alkaline earth metal compound, a calcium hydroxide, a barium hydroxide, a magnesium hydroxide, a strontium hydroxide, calcium hydrogencarbonate, barium hydrogen carbonate, carbonic acid hydrogen magnesium, carbonic acid hydrogen strontium, a calcium carbonate, a barium carbonate, a magnesium carbonate, a strontium carbonate, calcium acetate, barium acetate, magnesium acetate, strontium acetate, calcium stearate, barium stearate, magnesium stearate, stearin acid strontium, etc. are mentioned, for example.

[0027] As an example of a basic boron compound, hydroxides, such as tetramethyl boron, tetraethyl boron, tetra-propyl boron, tetrabutyl boron, trimethyl ethyl boron, trimethyl benzyl boron, trimethyl phenyl boron, triethyl methyl boron, triethyl benzyl boron, triethyl phenyl boron, tributyl benzyl boron, tributyl phenyl boron, tetra-phenyl boron, benzyl triphenyl boron, methyl triphenyl boron, and butyl triphenyl boron, are mentioned.

[0028] As basic phosphorus compounds, a triethyl phosphine, a tree n-propyl phosphine, a triisopropyl phosphine, tri-n-butyl phosphine, triphenyl phosphine, tributyl phosphine, or the fourth class phosphonium salt is mentioned, for example.

[0029] As a basic ammonium compound, for example Tetramethylammonium hydroxide, Tetraethylammonium hydroxide, tetrapropylammonium hydroxide, Tetrabutylammonium hydroxide, trimethyl ethylammonium hydroxide, Trimethyl benzyl ammonium hydroxide, trimethyl phenyl ammonium hydroxide, Triethyl methylammonium hydroxide, triethyl benzyl ammonium hydroxide, Triethyl phenyl ammonium hydroxide, tributyl benzyl ammonium hydroxide, Tributyl phenyl ammonium hydroxide, tetra-phenyl ammonium hydroxide, benzyl

triphenyl ammonium hydroxide, methyl triphenyl ammonium hydroxide, butyl triphenyl ammonium hydroxide, etc. are mentioned.

[0030] As an amine system compound, 4-aminopyridine, 2-aminopyridine, N, and N-dimethyl-4-aminopyridine, 4-diethylamino pyridine, 2-hydroxypyridine, 2-methoxy pyridine, 4-methoxy pyridine, 2-dimethylamino imidazole, 2-methoxy imidazole, an imidazole, 2-mercaptoimidazole, 2-methylimidazole, an amino quinoline, etc. are mentioned, for example.

[0031] In this invention, as polymerization equipment which is made to carry out the ester exchange reaction of the carbonic acid diester to an aromatic series dihydroxy compound, and manufactures an aromatic series polycarbonate continuously, as shown in drawing 1, the equipment which consists only of the vertical-type churning reactor of three to 5 tub allotted to the serial is used. In two or less tubs, debasement, such as hue aggravation, foreign matter mixing, etc. by it being difficult to manufacture the polycarbonate of the molecular weight made into the purpose and the amount of end hydroxy groups, and the demerit in the point of equipment cost or operability becoming large in six or more tubs, and a process becoming long, will be caused.

[0032] Usually, a reaction is substantially performed under anoxia, for example, permutes the inside of a raw material equalizing tank, a reactor, and piping with inert gas, such as nitrogen gas, before the start up. The melting mixture of an aromatic series dihydroxy compound and carbonic acid diester is supplied to the vertical-type reactor 3 through Rhine 1. A catalyst may be directly supplied to the 1st reaction vessel in Rhine different from a raw material, and may be supplied in the condition of having mixed with the raw material by the static mixer etc. within piping of this side included in the 1st reaction vessel. The solvent for accepting the need, and dissolving or suspending a catalyst is used. Water, an acetone, a phenol, etc. are mentioned as a desirable solvent.

[0033] The liquid feed hopper of each tub is in the reaction-vessel side-attachment-wall liquid phase section, and, as for draw opening, it is desirable that it is in the reaction bottom of the tank section. Moreover, as for the approach of extracting reaction mixture continuously from each tub, it is desirable to carry out by approaches which were adapted for the physical properties of reaction mixture, such as an approach using liquid-sending pumps, such as an approach of using fall, a method of using differential pressure, and a gear pump.

[0034] The range of 140-320 degrees C of reaction temperature is 180 degrees C - 300 degrees C preferably, reaction pressure is performed on the conditions of 800 or less Torrs, and it reacts, removing continuously the mono-phenolic compound which raises and carries out the byproduction of whenever [ temperature and reduced pressure ] gradually from Rhine 2. At this time, inert gas, such as nitrogen, can also be circulated if needed. Moreover, in order to return the raw material accompanied to a mono-phenolic compound to a reaction vessel, a fractionating tower can also be attached to a reactor.

[0035] As for the residence time of each reaction vessel, controlling by liquid level in a tub is desirable, for example, the automatic control in the residence time of arbitration of it becomes possible by combining the control valve and liquid-sending pump which are attached to a liquid level indicator, a reaction mixture inlet port, or an outlet. The residence time of each tub is usually preferably performed in 20 - 90 minutes for 10 to 120 minutes.

[0036] According to the viscosity of the reaction mixture of each tub, although the impeller used has the usable thing of the configuration of arbitration Although the melt viscosity of a reaction mixture is suitable for use of a propeller aerofoil, a turbine blade, a paddle aerofoil, a support aerofoil, etc. in a reaction vessel 100poise or less and use of a paddle aerofoil, a support aerofoil, a ribbon aerofoil, a screw aerofoil, a torsion grid aerofoil, etc. becomes suitable in the tub which exceeds 100poise Especially, in this invention, polycarbonate manufacture of high quality is attained more by using the high single helical ribbon aerofoil or double helical ribbon aerofoil of the renewal nature of a front face as an impeller of the last tub

at least. In addition, special configuration paddle aerofoils, such as a full zone aerofoil (trade name), are also contained in a support aerofoil at a paddle aerofoil, also including amelioration support type aerofoils (a chemical engineering handbook, the 911st term of the 5th edition of revision; \*\*\*\*\*), such as the Max blend aerofoil and a screw anchor aerofoil. A baffle may be formed in a reaction-vessel wall if needed in order to gather tub churning effectiveness.

[0037] Although the manufactured aromatic series polycarbonates are usually collected as a pellet after polymerization termination, since low daily dose components which remain in resin, such as a monomer and a by-product, are removed, it is also possible in that case to let a vent type extruder pass.

[0038] Additives, such as the usual heat-resistant stabilizer, an ultraviolet ray absorbent, a release agent, a coloring agent, an antistatic agent, a slipping agent, an anti blocking agent, lubricant, an antifogger, natural oil, synthetic oil, a wax, an organic system bulking agent, and an inorganic system bulking agent, may be added to the aromatic series polycarbonate obtained by this invention. Such an additive remelts the resin which could also add to the resin in a melting condition, and was once pelletized, and can also be added.

[0039]

[Example] Hereafter, although an example explains this invention, this invention is not limited to these examples. Analysis of the aromatic series polycarbonate obtained by this invention was performed with the following measuring methods.

[0040] (1) 20-degree C limiting viscosity [eta] was measured among the methylene chloride using the viscosity-average-molecular-weight ubellohde's viscosimeter, and it asked from the following formulas.

[eta] =  $1.23 \times 10^{-4} x (Mv)^{0.83}$  [0041] (2) By the amount titanium-tetrachloride of end hydroxy groups coloring method, the 546nm absorbance of the polymer dissolved in the titanium-tetrachloride-acetic-acid-methylene chloride solution was measured, and it computed from the calibration curve created using bisphenol A.

[0042] (3) 10% methylene chloride solution of hues was put into the glass cel with a diameter [ of 25mm ], and a height of 55mm, the tristimulus values XYZ which are absolute values of a color were measured with the color circuit tester (SC[ by Suga Test Instruments Co., Ltd. ]-1-CH), and YI value which is the index of whenever [ yellow ] was calculated with the following relational expression.

$YI = 100 / Y(1.28X - 1.06Z)$

Coloring, so that this YI value is large is shown.

[0043] (4) The amount of dust (5-10 micrometers) in the polymer 20 hours after the amount start up of foreign matters was measured by the light-scattering type sensor method.

[0044] the product made from example 1 stainless steel – the 100l. vertical-type churning reactor was connected to 3 tub serial, and the double helical ribbon aerofoil was provided [ the paddle aerofoil ] for the Max blend aerofoil in the 3rd reaction vessel at the 2nd reaction vessel at the 1st reaction vessel. Moreover, the fractionating tower was provided in the 1st and 2nd tub. These reactors permuted the inside of a system with nitrogen gas beforehand, and made it the anoxia ambient atmosphere. The 1st and 2nd tub controlled the oil level by control-valve opening prepared in reaction mixture discharge Rhine of a level indicator and the bottom of the tank section, and the 3rd tub controlled the oil level by combination of the gear pump of a level indicator and the bottom of the tank section. The melting mixing raw material liquid which prepared bisphenol A and diphenyl carbonate by the mole ratio (diphenyl carbonate / bisphenol A) 1.10 was continuously supplied to the 1st tub by the flow rate of 91.3kg/o'clock. Moreover, the cesium carbonate water solution was continuously supplied to the 1st tub by the flow rate of 1.5xten - six mols to one mol of bisphenol A as a catalyst. It was sent to the following reaction vessel one by one, the reaction mixture of the 1st tub maintaining the predetermined residence time, and, finally extracted the polymer continuously from the 3rd tub.

The service condition of each reactor and a result are shown in Table 1.

[0045] Various the numbers of tubs, the shape of a profile, and service conditions of an example 2 - 7 vertical-type churning reaction vessel were changed, and the polycarbonate was manufactured. The service condition of each reactor and a result are shown in Table 1.

[0046] the product made from stainless steel which possesses a paddle aerofoil as the example of comparison 1 1st reactor -- a 100l. vertical-type churning reaction vessel and the product made from stainless steel which possesses the Max blend aerofoil as the 2nd reactor - - a 100l. vertical-type churning reaction vessel and the product made from stainless steel which possesses a glasses aerofoil as the 3rd reactor -- the polycarbonate was manufactured using the 150l. horizontal-type biaxial churning polymerization machine. The service condition of each reactor and a result are shown in Table 2.

[0047] the product made from example of comparison 2 stainless steel -- the 200l. vertical-type churning reaction vessel was connected to 2 tub serial, and the polycarbonate was manufactured using the polymerization equipment which possessed the Max blend aerofoil in the 1st reactor, and possesses a double helical ribbon aerofoil in the 2nd reactor. The service condition of each reactor and a result are shown in Table 2.

[0048] the example 3 of a comparison - the product made from 4 stainless steel -- the number of tubs, the shape of a profile, and service condition of a 100l. vertical-type reactor were changed, and the polycarbonate was manufactured. The service condition of each reaction vessel and a result are shown in Table 2.

[0049]

[Table 1]



条 件	実施例 1	実施例 2	実施例 3	実施例 4	実施例 5	実施例 6	実施例 7
UPC/BPA	1.10	1.08	1.06	1.08	1.08	1.08	1.12
触 媒	Cs2CO3	Cs2CO3	Cs2CO3	Cs2CO3	CsOH	Ph4BNa	Cs2CO3
触媒量 $\mu\text{mol/BPA}$	1.5	1.5	1.5	1.5	0.7	6.0	0.7
槽 数	3	4	5	4	4	4	4
第 1 槽	翼形状	ハート形	ハート形	ハート形	ハート形	ハート形	ハート形
	温度 $^{\circ}\text{C}$	220	220	220	220	220	210
	圧力 Torr	100	100	100	100	100	760
	滞留時間 min	60	60	60	60	60	30
	攪拌速度 rpm	160	160	160	160	160	160
第 2 槽	翼形状	MB	MB	MB	MB	MB	MB
	温度 $^{\circ}\text{C}$	250	240	240	240	240	240
	圧力 Torr	15	15	15	15	15	100
	滞留時間 min	60	40	40	60	40	60
	攪拌速度 rpm	100	160	160	160	160	160
第 3 槽	翼形状	DHR	SHR	MB	MB	SHR	SHR
	温度 $^{\circ}\text{C}$	280	260	260	260	275	270
	圧力 Torr	0.2	2	2	1	2	2
	滞留時間 min	80	60	60	60	60	60
	攪拌速度 rpm	25	50	100	100	50	50
第 4 槽	翼形状		DHR	SHR	SHR	DHR	DHR
	温度 $^{\circ}\text{C}$		280	275	280	290	280
	圧力 Torr		0.5	0.5	0.5	0.5	0.5
	滞留時間 min		60	40	80	60	60
	攪拌速度 rpm		25	50	50	25	25
第 5 槽	翼形状			DHR			
	温度 $^{\circ}\text{C}$			290			
	圧力 Torr			0.5			
	滞留時間 min			40			
	攪拌速度 rpm			25			
Mv	15,500	17,000	19,000	16,400	16,600	16,800	15,600
OH量 ppm	720	340	330	580	400	380	450
色相 (YI)	0.9	1.1	1.3	1.5	1.3	1.2	0.9
異物量 個/g	18	31	40	36	33	48	27

MB : マックスブレンド翼

SHR : シングルヘリカルリボン翼

DHR : ダブルヘリカルリボン翼

[0050]

[Table 2]



[Translation done.]

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CLAIMS

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[Claim(s)]

[Claim 1] To a raw material, an alkali metal compound and/or  $1 \times 10^{-8}$  to  $1 \times 10^{-5}$  mols of alkaline earth metal compounds are used for an aromatic series dihydroxy compound and carbonic acid diester to one mol of aromatic series dihydroxy compounds as a catalyst. In the approach of manufacturing an aromatic series polycarbonate by the ester exchange reaction, only the vertical-type churning reactor of three to five tub allotted to the serial as a reactor is used. Viscosity average molecular weight continuously by 10,000-20,000 And the manufacturing method of the polycarbonate for optics characterized by manufacturing the polycarbonate whose amount of end hydroxy groups is 1,000 ppm or less.

[Claim 2] The manufacturing method of the polycarbonate for optics of a vertical-type churning reactor according to claim 1 which uses a single helical ribbon aerofoil or a double helical ribbon aerofoil for the last tub as an impeller at least.

[Claim 3] The manufacturing method of the polycarbonate for optics of a vertical-type churning reactor according to claim 1 which uses a double helical ribbon aerofoil for the last tub as an impeller at least.

[Claim 4] The manufacturing method of the polycarbonate for optics according to claim 1 to 3 an aromatic series dihydroxy compound and whose carbonic acid diester are 2 and 2-screw (4-hydroxyphenyl) propane and diphenyl carbonate.

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[Translation done.]